

Science For Coastal Wetland Restoration

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US Army Corps of Engineers
BUILDING STRONG®

Coastal Wetlands Restoration



**Beneficial Usage of
Dredge Material**



Regulatory Mitigation



Ecosystem Restoration



Wetland Restoration

1. **Determine what the system used to be before it was altered (Investigation)**
2. **Determine the current situation (Scientific evaluation)**
3. **Determine if any or all of the changes are reversible (Scientific evaluation)**
4. **Determine what the most appropriate future condition (Scientific evaluation)**



Determine what the system used to be before it was altered (Investigation)



- Historical records
- Maps
- Photographs

North between Secs 29 & 30 S 12 W
R 27 W.

18 21 Elm 8 ins dia.

28 14 Long Clear Lake 300 lks wide, calculated.

40 00 Set 1/4 Sec cor post from which Hackberry
10 ins dia bro Ash 8 1/4 lks. & an Elm 14
ins dia bro S 7 E 13 lks.

61 20 Overcup Oak 20 ins dia.

80 00 Set cor post to Secs 19, 20, 29 & 30, from
which an Overcup Oak 12 ins dia bro
S 7 E 13 lks. a Post Oak 22 ins dia bro
S 29 E 99 lks. a Hickory 18 ins dia bro
S 12 W 85 lks. & an Ash 12 ins dia bro
N 41 W 45 lks.

Land mostly wet, was annually
inundated, then an Overcup Willow
Oak Hackberry &c. large green birch
vine & some cane. Dec 17 th.

Coast on a random line between
Secs 20 & 29, S 12 S R 27 W.

40 00 Set temporary 1/4 Sec cor post,
1 10 Long clear lake 210 lks wide, calculated.

80 17 Intersected line 14 lks S. of cor. to
Secs 20, 21, 28 & 29.
Land, birch & wet tim br. Will.

✓ West on true line between Sec. 29 & 30-T 12 S-R 27 W-

15.17 Hackberry 11 ins. dia.

39.95 Set 1/4 Sec. corner post from which a hackberry 7 ins. dia. bears
N 6 E 17 lks end an Elm 8 ins. dia. bears S 14 W 14 lks--

79.92 Intersected corner.--

✓ West between Sec. 30 & 31-T 12 S-R 27 W-

19.57 Ash 8 ins. dia.

40.00 Set 1/4 Sec. corner post from which an ash 8 ins. dia. bears
South 6 links & an ash 11 ins. dia. bears N 42 W 10 links--

55.24 Ash 8 ins. dia.

84.14 Intersected line 36 links S of corner whereat set corner post from
which an ash 10 ins. dia. bears N 69 E 47 links and Willow Oak
Oak 16 ins. dia. bears S 79 E 43 links--

Land level wet & subject to overflow timber Overcup Oak
Willow Oak, Ash & Undergrowth green briars & vines

✓ North between Sec. 29 & 30 T 12 S-R 27 W--

18.21 Elm 8 ins. dia.

23.14 Long clear Lake 340 lks wide (calculated)

40.00 Set 1/4 Sec corner post from which a hackberry 10 ins. dia.
bears N 50 E 14 lks end an Elm 8 ins. dia. bears S 7 E 13 lks--

61.20 Overcup Oak 20 ins. dia.

80.00 Set corner post to Secs. 19, 20, 29 & 30 from which an Overcup
Oak 12 ins. dia. bears N 37 E 13 links, a post oak 22 ins. dia.
bears S 25 E 99 links, a hickory 18 ins. dia. bears S 12 W 85
links and an ash 12 ins. dia. bears S 12 W 85 links and an ash
12 ins. dia. bears N 41 W 45 links

Land mostly wet & annually inundated timber Overcup Willow Oak
hackberry & Undergrowth green briars vines & some cane--
Dec 17

✓ East on a random line between Sec. 30 & 29-T 12 S-R 27 W-

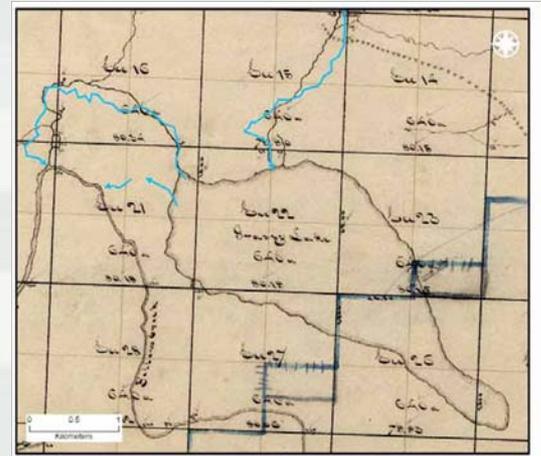
40.30 Set temporary 1/4 Sec corner post

67.10 Long clear lake 210 lks wide calculated

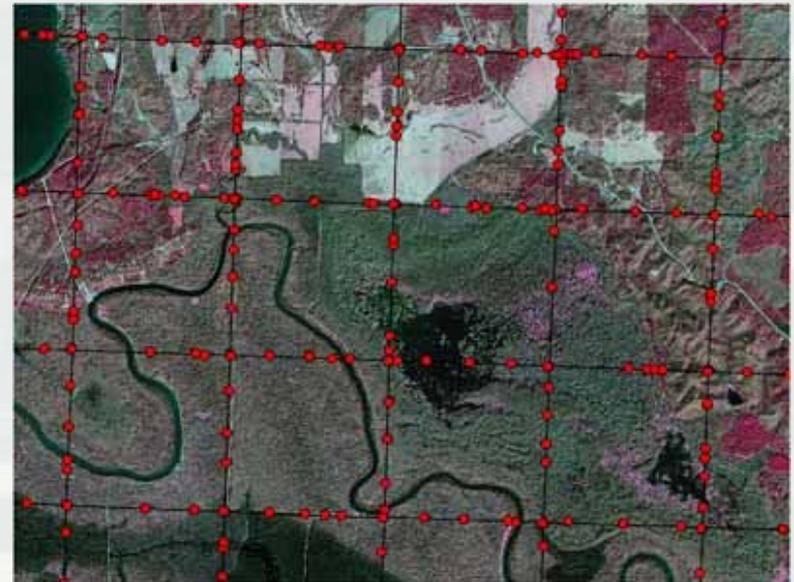
80.17 Intersected corner 14 lks S. of corner to Secs 20, 21, 28 & 29
Land level & wet timber Willow Oak hickory & Undergrowth green
briars & some cane.

✓ West on true line between Sec. 20 & 29-T 12 S-R 27 W

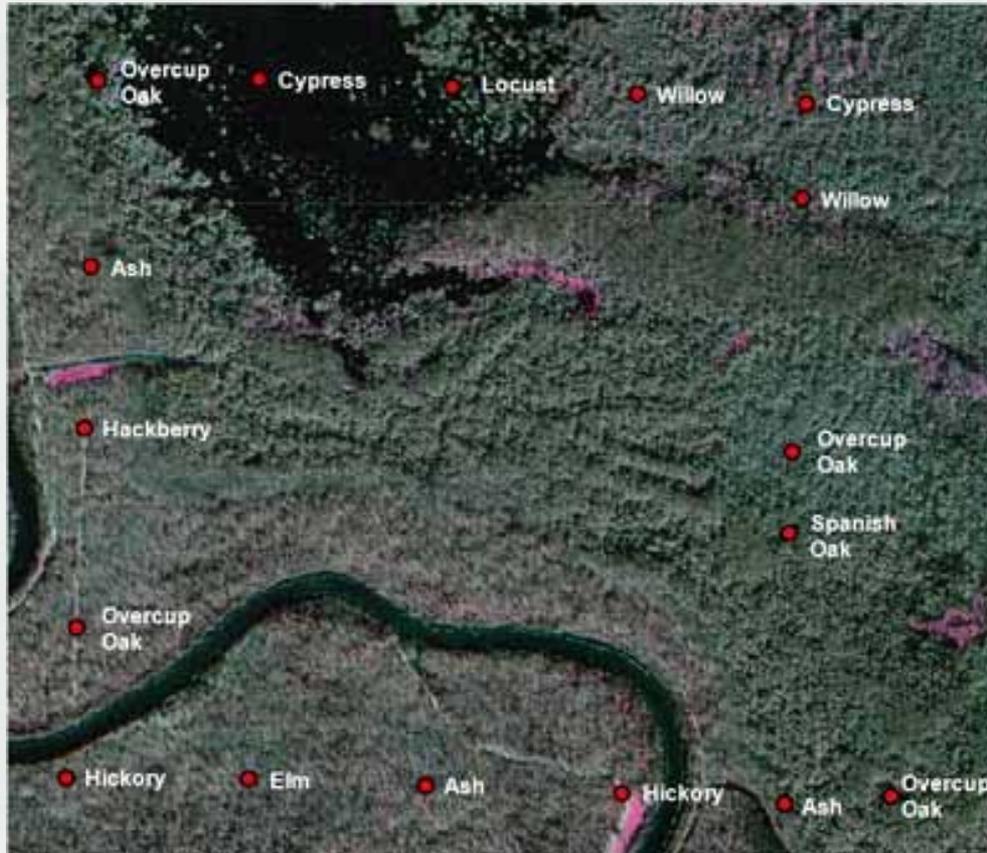
17.19 Hickory 10 ins. dia.



Attempt to match the historical data with current information



Attempt to match the historical data with current information



North Station Dec 29 + Co S 12 N
 Dec 27 th

16 21 Clear 8 in air
 20 14 Long Clear Lake 100 in air, Green Lake
 20 01 Dec 14 Dec Co post from which a Hackberry
 10 in air Co S 12 N Co S 14 N Co S 14 N
 in air Co S 14 N Co S 14 N
 61 20 Overcup Oak 12 in air
 80 01 Dec Co post to Dec 19. 21. 29 + Co. form
 which an Overcup Oak 12 in air Co
 S 14 N Co S 14 N a Hackberry 12 in air Co
 S 14 N Co S 14 N a Hackberry 12 in air Co
 S 14 N Co S 14 N a Hackberry 12 in air Co
 S 14 N Co S 14 N

Land mostly level and generally
 main dunes. Tim Co Overcup. Will Co
 Oak Hackberry + c. length green trees
 Tim + some cane. Dec 17 th

East on a random line between
 Dec 21 + 29, S 12 S R 27 th

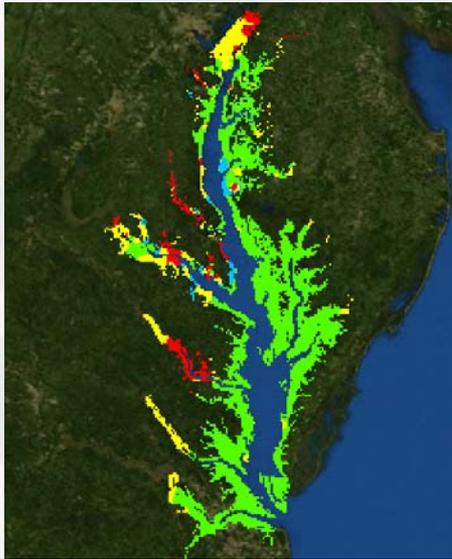
40 01 Dec temporary to Dec Co post
 1 10 Long thin lake 210 the wide Clear Lake
 80 17 Intersected line 14 the S. of Co. to
 Dec 21. 27 + 29.

Land level + wet top Co. Will Co



Determine if any or all of the changes are reversible. (Scientific evaluation)

- Site evaluation
- Physical assessment (soils, water, etc)
- Biological assessment
- Chemical assessment
- Areal photography



Salinity >5
Depth <20'
DO >5mg/L



Modifications



Modeling



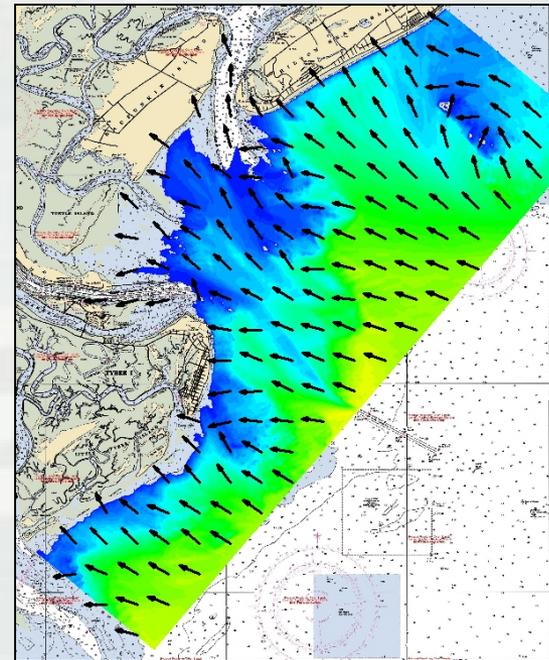
Determine what the most appropriate future condition (Scientific evaluation)

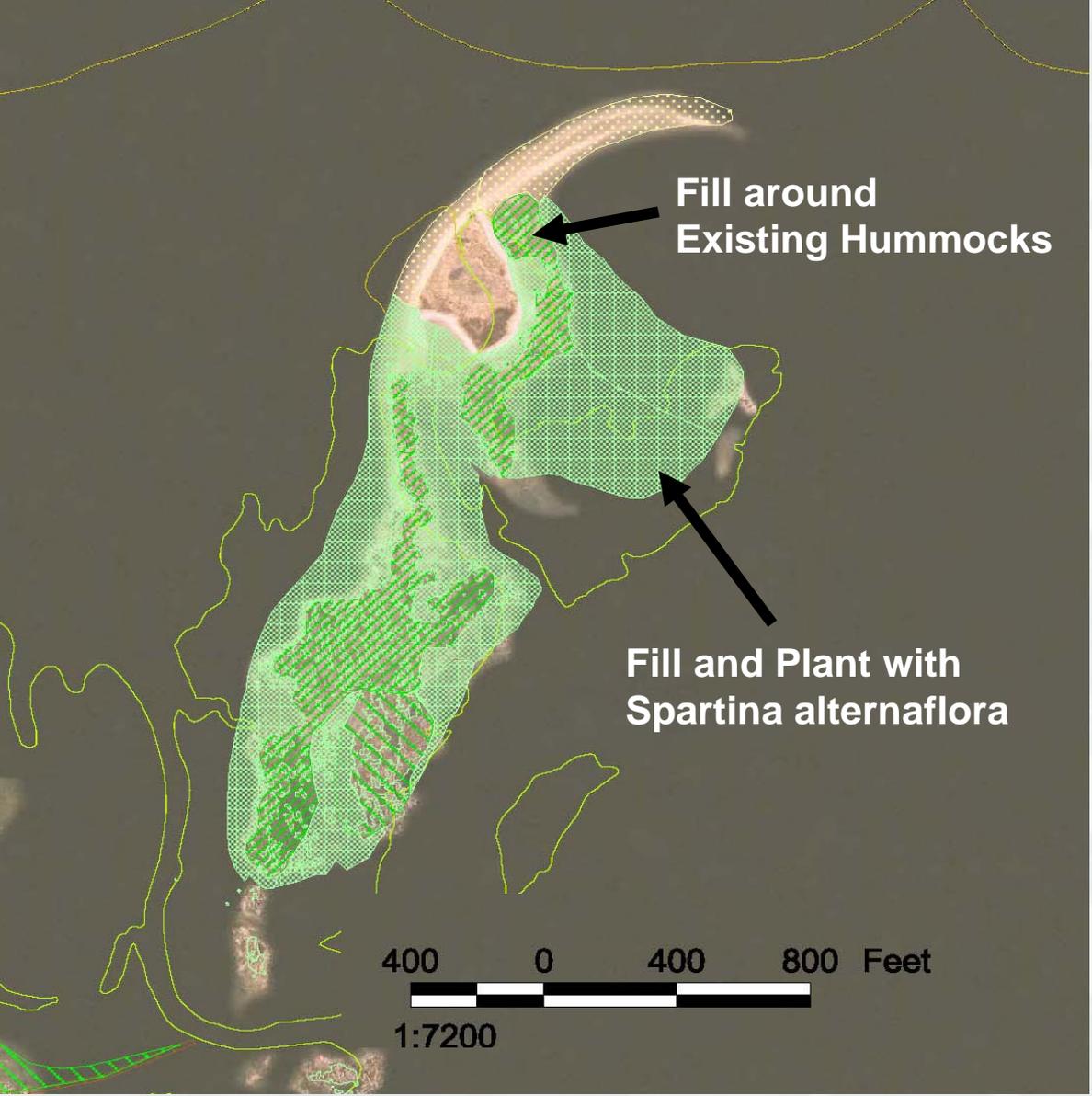
- Physical assessment (soils, water, etc)
- Biological assessment
- Chemical assessment
- Visualization



Corps of Engineer Districts Build Ecosystem Restoration Projects

ERDC Laboratories Attempt To Make Them Better





Elder Point Mitigation/ Restoration Design



Sand From Floyd Bennett Field Transported to Elders Point



**Research is being conducted on long
distance conveyance**

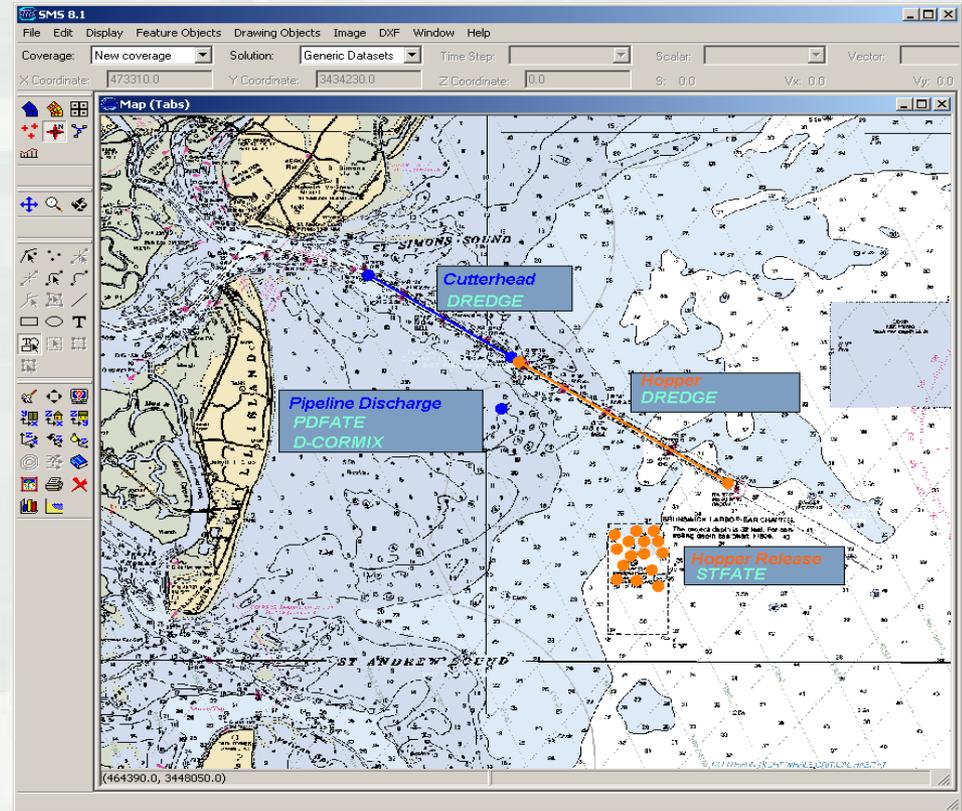


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Surface Water Modeling System (SMS) Toolbox for Dredging Models and Data

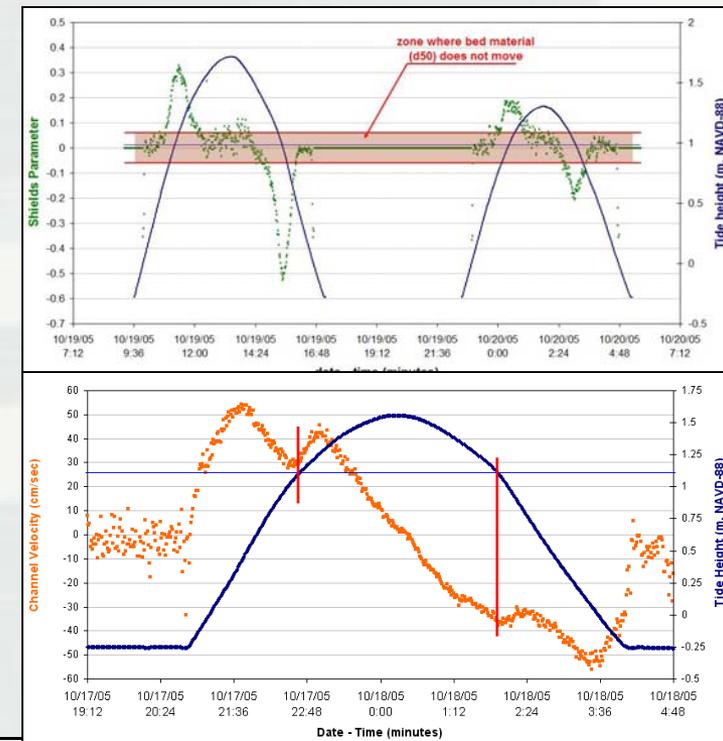
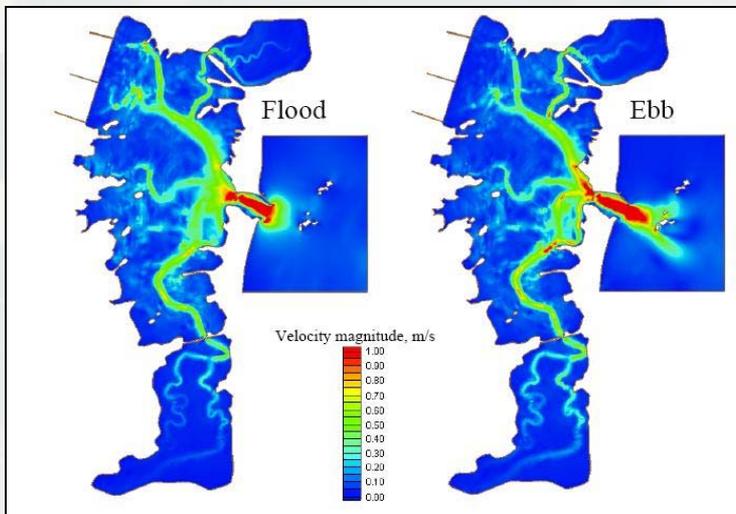
Provides Staff with:

- Comprehensive management system for models and data
- Interconnectivity with other Corps models (hydro, waves, etc)
- Efficient connectivity to external data sources
- Dredge-specific databases
- Interconnectivity between dredging models
- Efficient model setup
- Visualization and analysis tools



Coastal Simulation – Wetland Processes

- Define geomorphic relationships
 - ▶ Relating: channel density, width, depth, and sinuosity to: tidal prism, diurnal tidal prism, tidal range and datums (wrt marsh elevation)
- Model coastal wetland hydraulics and sediment transport
 - ▶ ADH and ADCIRC





Establishment of Vegetation



Thin Layer Placement of Dredge Material on Coastal Wetlands



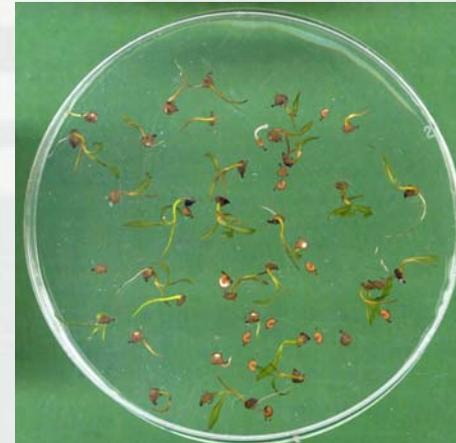
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Submerged Aquatic Vegetation Restoration (Underwater Grasses)



Innovative Harvesting and Planting Techniques



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SAV Restoration Methods: Seeds

1. Repro. shoot collection



2. Seed extraction and storage



3. Seed dispersal

3a. Broadcasting



3b. Direct Injection



3c. Seed buoy



Large-Scale SAV Seed Planting Projects



Location	Species	Recipient	Duration	Acres
Piankatank River, VA	<i>Z. marina</i>	VIMS	2003-2005	40
Potomac River, MD	<i>Z. marina</i>	MD DNR	2003-2006	37.25
Patuxent River, MD	<i>Z. marina</i>	MD DNR	2003-2005	23.75
Poplar Island, MD	<i>P. perfoliatus</i> <i>R. maritima</i>	AACC	2004	12
Barren Island, MD	<i>R. maritima</i>	AACC	2005	3
Various	Various	Various	2004-2005	16.5

Abbreviations: VIMS (Virginia Institute of Marine Science); MD DNR (Maryland Dept. of Natural Resources); UMCES (University of Maryland Center for Environmental Science); KCF (Keith Campbell Foundation); MPA (Maryland Port Authority); NAIB (National Aquarium in Baltimore); ACB (Alliance for the Chesapeake Bay).

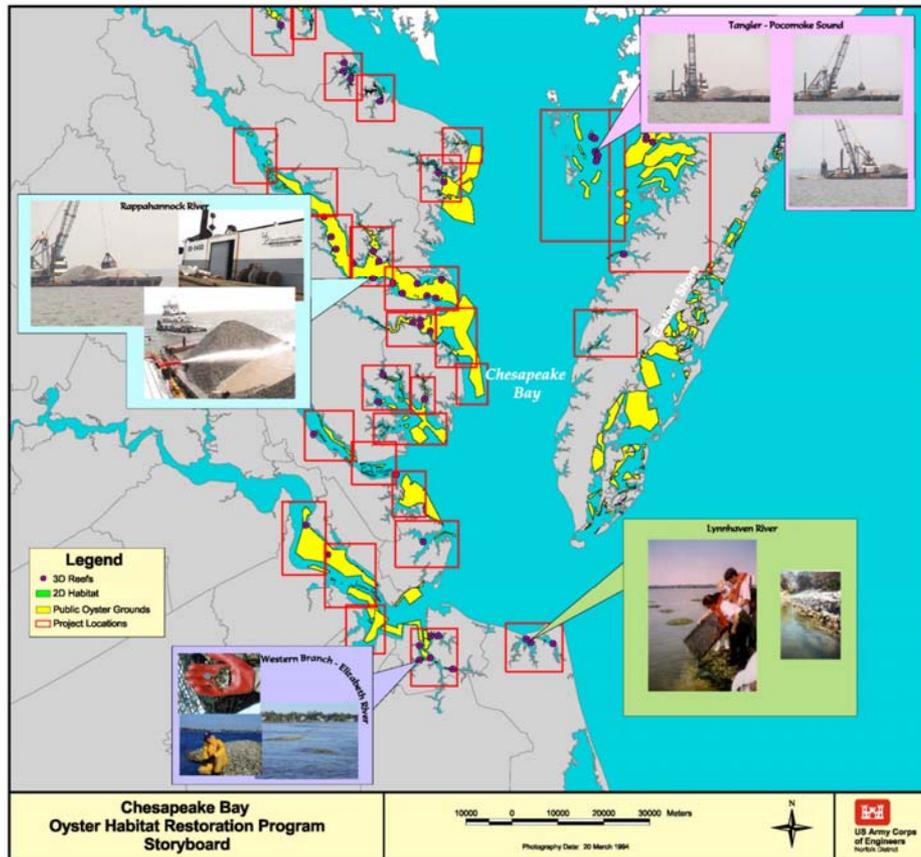


Black Mangrove Restoration in Plaquemines Parish, LA

- *Avicennia germinans* (black mangrove) restoration pilot study to test:
 - ▶ Restoration effectiveness
 - ▶ Potential donor populations
 - ▶ Cold tolerance
- **Impact:**
 - ▶ Ecosystem restoration
 - ▶ Shoreline stabilization
 - ▶ Wave attenuation
 - ▶ Levee protection and stabilization
- **Planting to begin FALL 2010**



Hydrodynamic Analysis



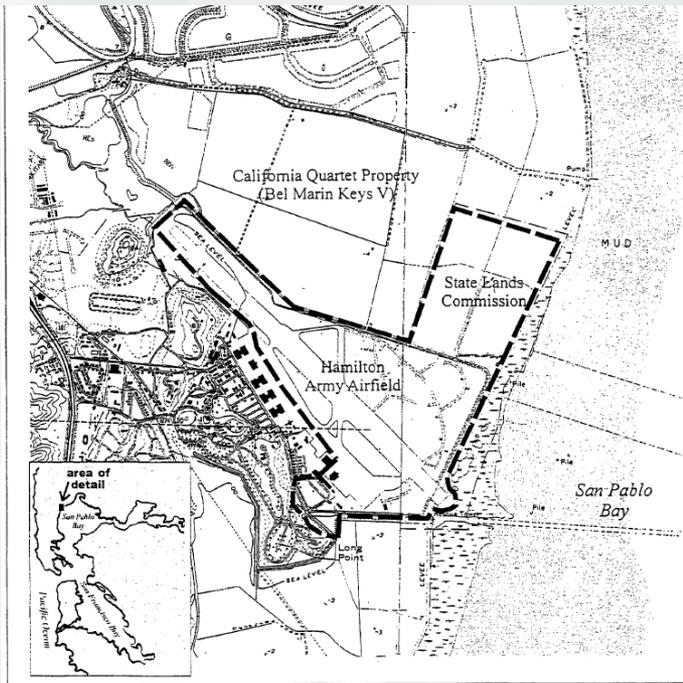
Absolute Criteria

- Salinity: >5 ppt
- Dissolved oxygen: >5 mg/L
- Water depth: < 20 feet
- Historic reef upstream extents
- Substrate capable of supporting shell

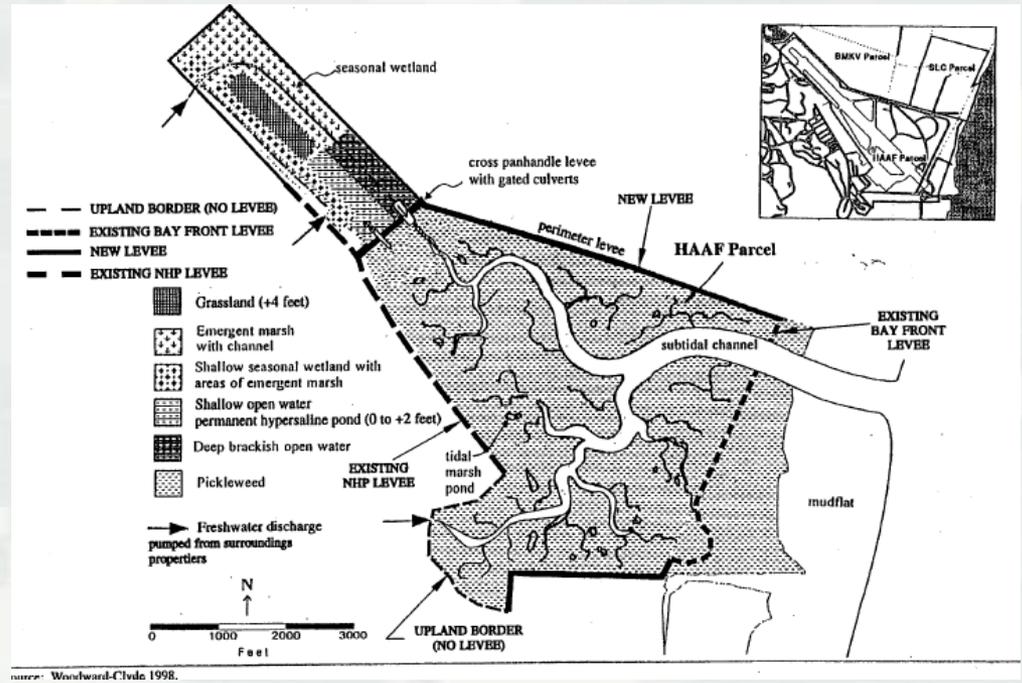


Hamilton Army Airfield

Historical



Restored Habitat





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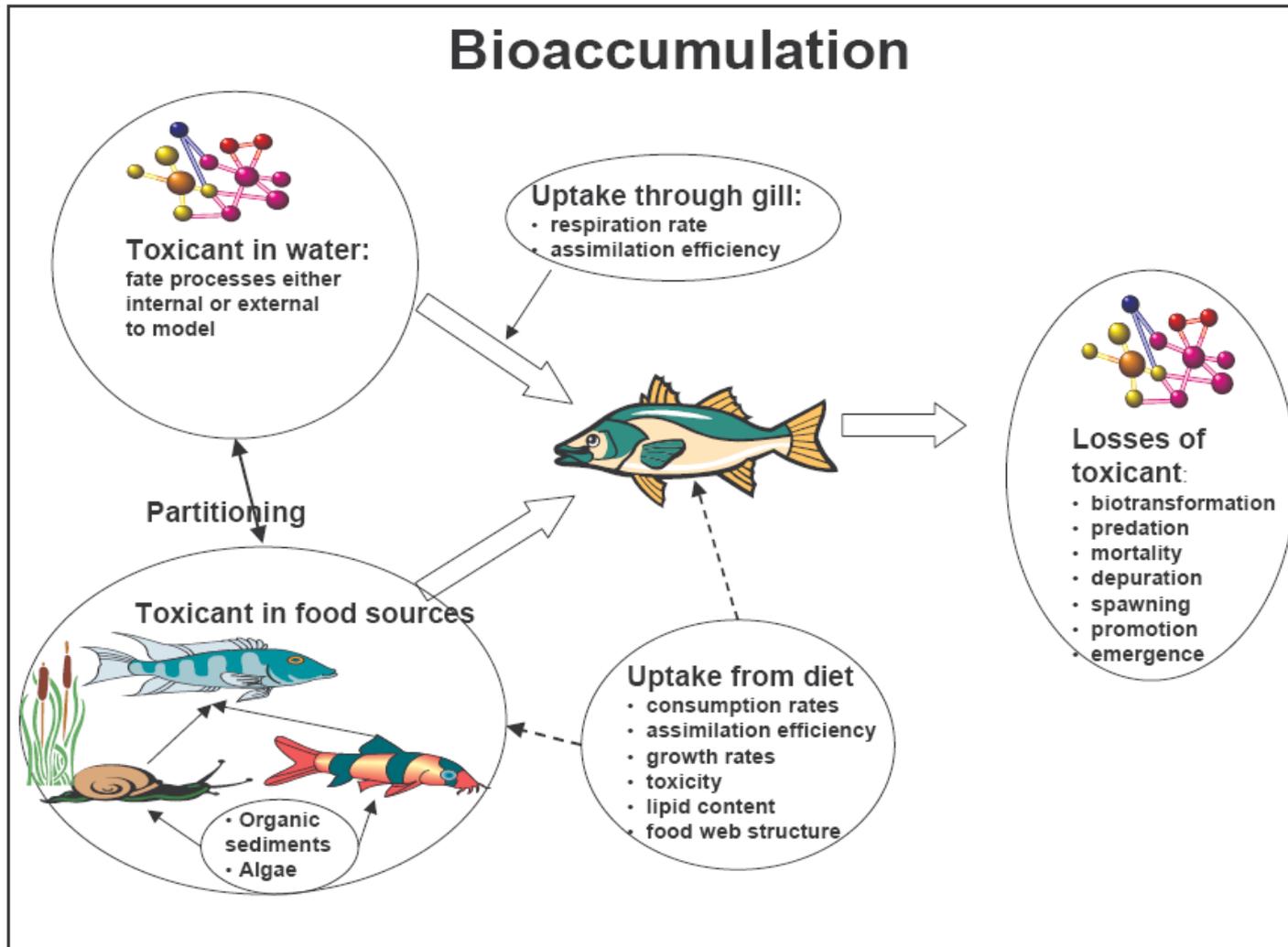
Monomethylmercury production



- **Mercury dynamics in food webs**
- **Characterization of Microbial community**
- **Bioavailability**



Bioaccumulation Modeling



Threatened and Endangered Species



- Protection
- Management
- Habitat Requirements



U.S. Army Corps of Engineers Dredged Material Research Program (DMRP)

Research objectives during the 1970s

- 1) Document use of dredged material islands by colonial nesting birds
- 2) Document succession of vegetation on these islands
- 3) Compare vegetation and bird use on diked and undiked islands
- 4) Compare vegetation and bird use of natural and man-made islands
- 5) Study year-round use of dredged material islands by nesting, migratory and wintering birds

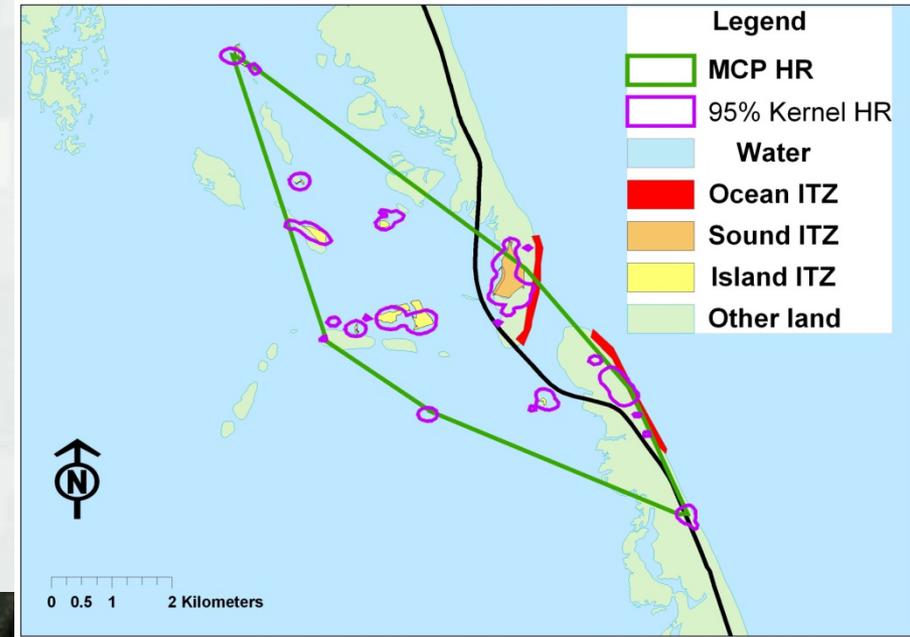




Regional Workshops

- 
- (1) to expand capabilities of the Corps to contribute to various bird conservation efforts,**
 - (2) to make the bird conservation community aware of opportunities that exist through working with the Corps, and**
 - (3) to address and hopefully reduce some areas of conflict.**

Winter Ecology of Piping Plovers at Oregon Inlet, North Carolina

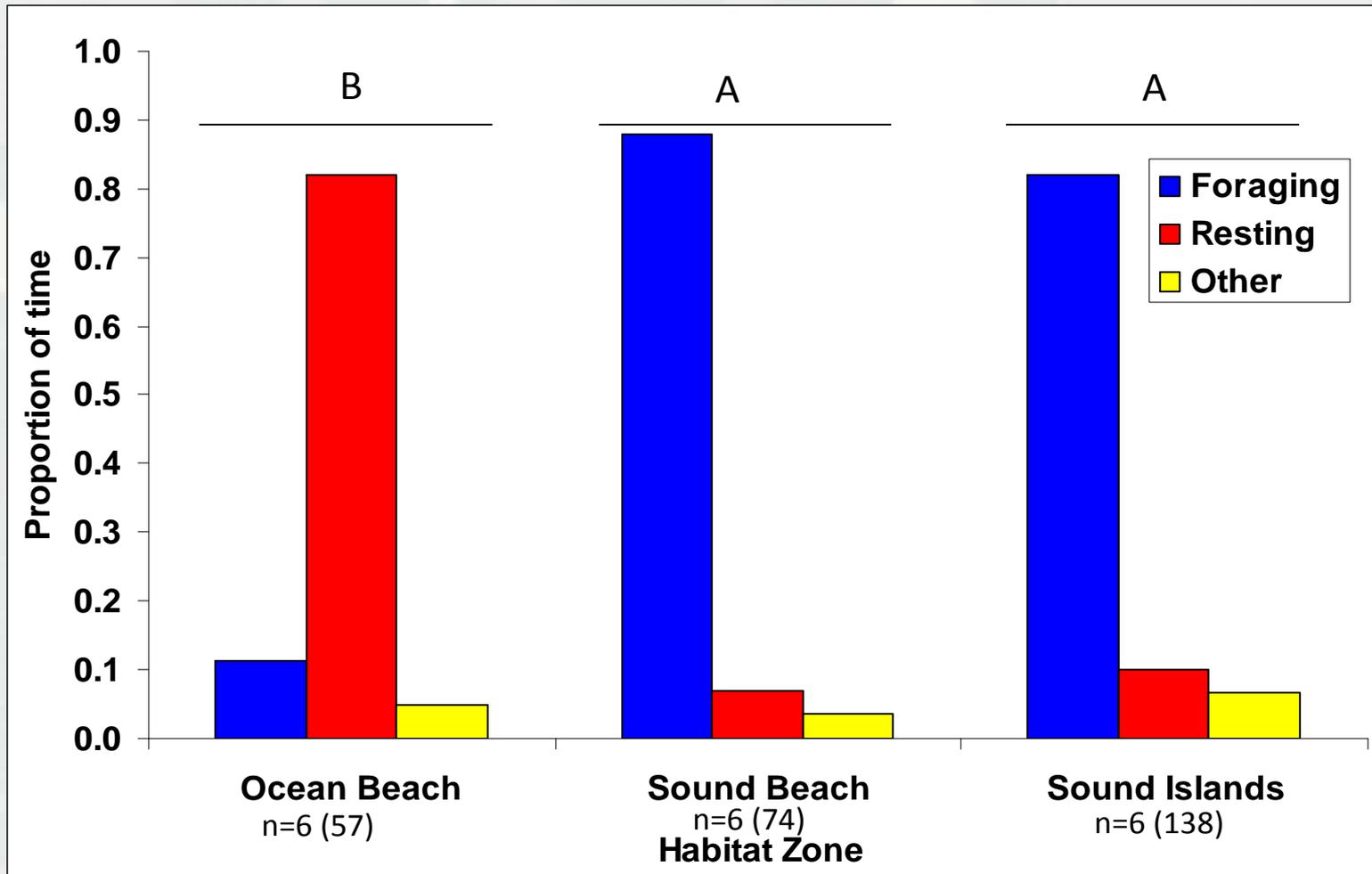


Collaborative research between ERDC and Department of Fisheries and Wildlife Sciences, Virginia Tech University



Results - Oregon Inlet, North Carolina

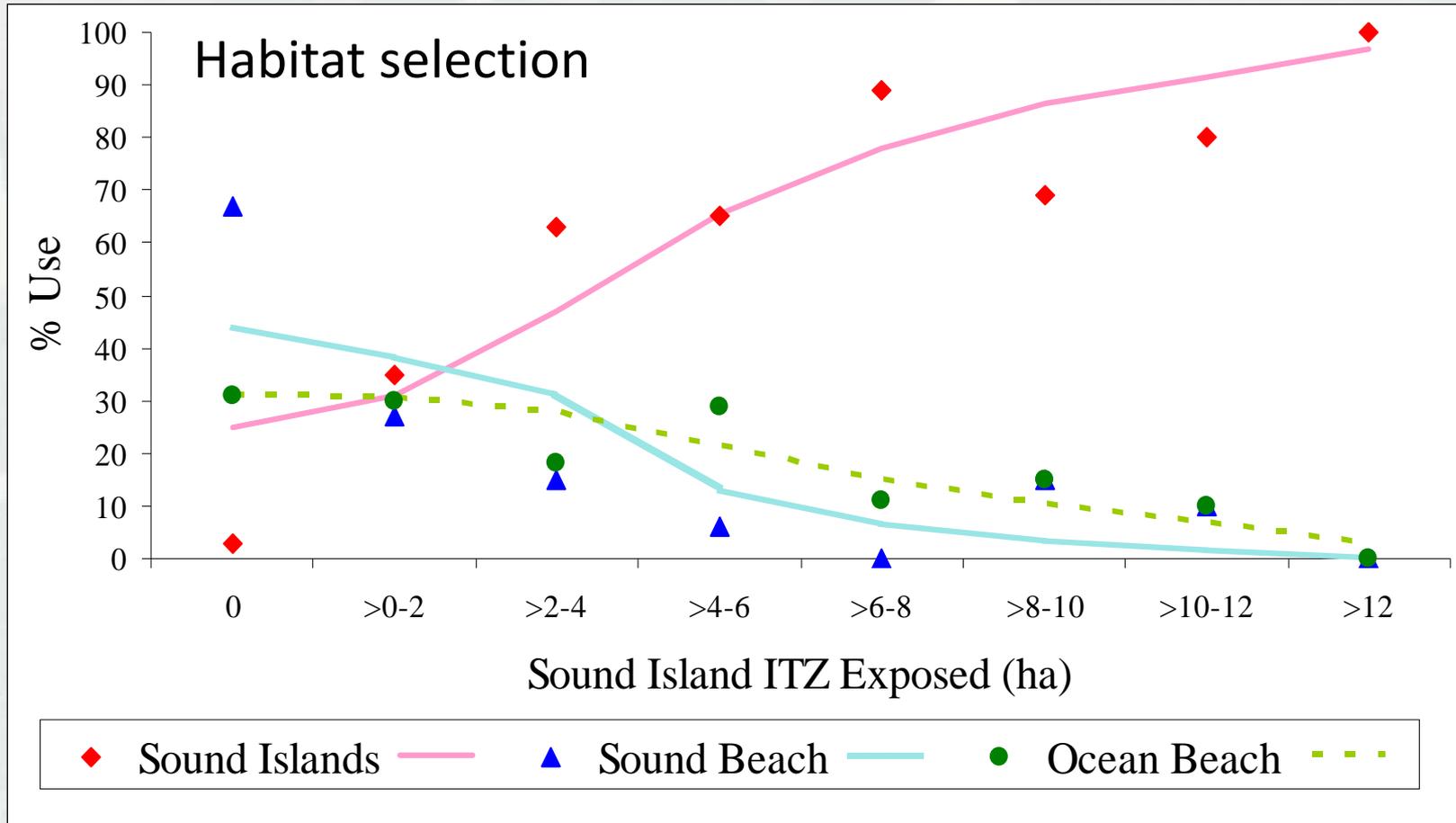
Piping Plover Activity Budgets



Multiresponse Blocked Permutation Procedure: $P = 0.003$



Results - Oregon Inlet, North Carolina



Multinomial Logistic regression: **Wald's $\chi^2_2 = 24.0, P < 0.001, N = 197$**



Decision, Planning and New Research

Directions:

- 1) Identify conflicts between coastal engineering projects and target bird species, and identify ways to reduce the impacts associated with these conflicts
- 2) Huge amounts of uncontaminated coastal sediments are dredged each year. Numerous opportunities exist to use this material for new island creation and coastal wetland/marsh and beach restoration.
- 3) Conditions on many dredged material islands have changed since the 1970's. How much maintenance is needed to improve populations of dependent birds?



Succession on dredged-material Islands



Year 0-1



Year 3-4



Year 4-5

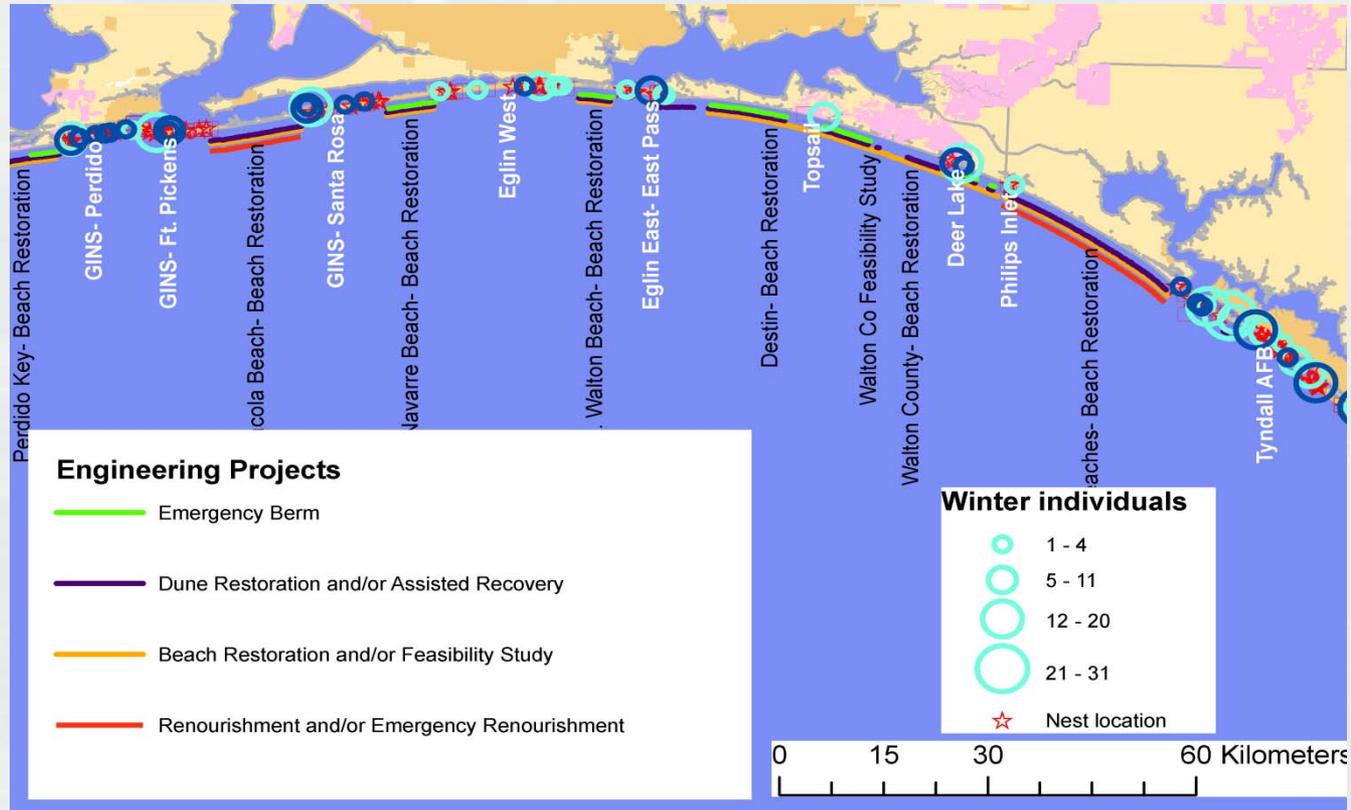


Year 7-10

Slide courtesy of Walker Golder, National Audubon Society



Factors that Limit Presence of Snowy Plovers in Florida



- SNPL not present in engineering project areas
- Is this due to habitat loss and/or disturbance?



Invasive Species



Phragmites australis

Management Technologies

- Chemical
- Mechanical
- Biological





Popular Island

Beneficial Usages of Dredge Material



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Questions



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